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(54) **Silencer**

(57) A silencer comprises a casing (10) having formed therein both an expansion chamber (22) and a silencing chamber (24), communication between the two being limited by means of a restrictor (26) of frusto-conical shape. Air or gas enters the expansion chamber (22) through an inlet (12) and exits via a smooth outlet bore (16) in a tubular member (20) carrying the restrictor (26) at one end and being secured to the end cap (18) of the casing (10) at the other end. The shape of the restrictor (26) causes turbulent air in the expansion chamber (22) to be deflected into the silencing chamber (24) and to be retained in this chamber for sufficient time to effect silencing. The silencer is described with particular reference to air guns, being secured via an external screwthread (14) to the muzzle of the gun, but can also be used with the exhausts of i.c. engines, air or gas operated equipment such as pneumatic drills, turbines or jet engines.

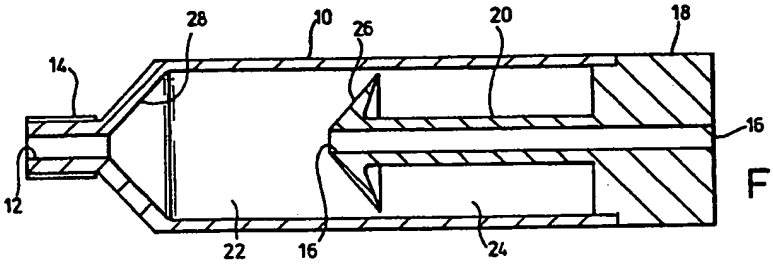

FIG.1.

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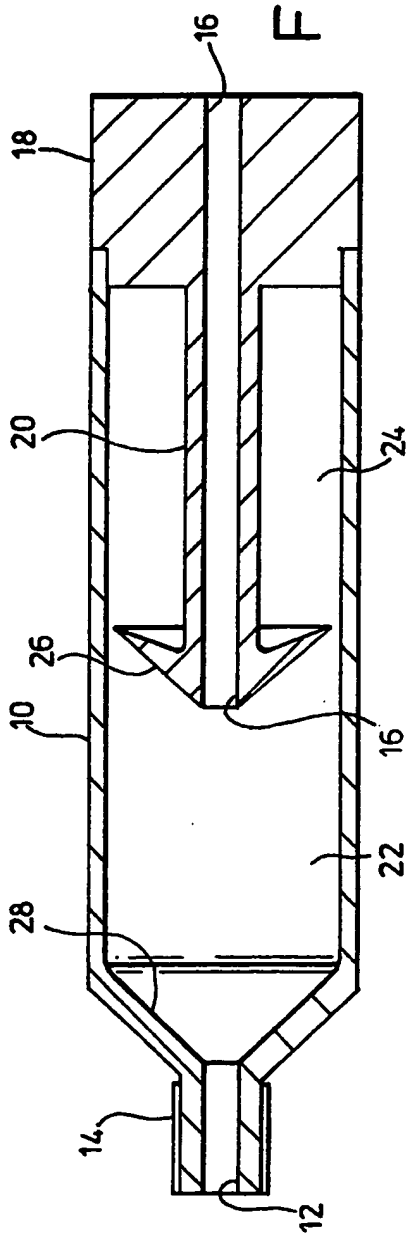

FIG.1.

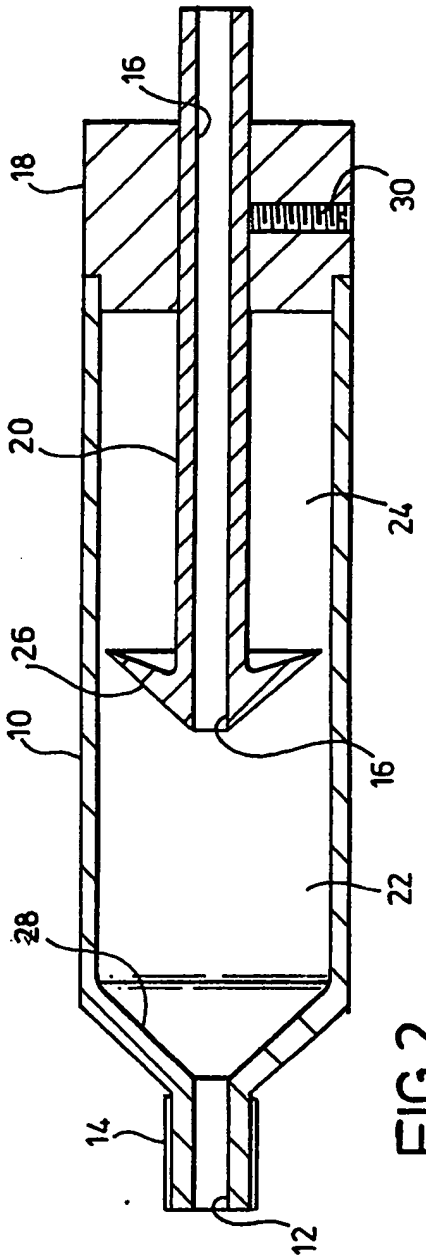

FIG.2.

SPECIFICATION

Improved silencing apparatus

This invention relates to silencing apparatus and more particularly, but not exclusively, to silencing apparatus for use on a gun such as an air weapon.

Previously, silencers for air weapons such as air rifles or pistols have consisted of an air expansion chamber in the silencer body having a series of springs mounted therein to effect smoothing and silencing of turbulant air flow. However, such known silencers are relatively inefficient and complicated to manufacture and the object of this invention is to provide a silencer of simpler construction than the above known silencer.

According to this invention, silencing apparatus comprises a casing having an inlet formed therein; an expansion chamber formed in the casing which is connected to the inlet; an outlet in the casing, in the form of a smooth parallel sided bore adapted to act as an air bearing, which is connected to the expansion chamber; a silencing chamber formed in the casing which is only connected to the expansion chamber; and restriction means for restricting communiciation between the expansion chamber and the silencing chamber wherein the restriction means slopes away from the expansion chamber towards the silencing chamber and is capable of reflecting turbulent gas or air flowing from the silencing chamber towards the expansion chamber back into the silencing chamber.

Preferably, the smooth parallel-sided outlet bore is formed in a member extending from the end of the casing remote from the inlet towards said inlet. Preferably, also, the outlet bore has a sharp edged orifice formed at the end thereof adjacent to the inlet. The restriction means, preferably, is secured to or formed on the end of the member having the outlet formed therein which is adjacent to the inlet.

Preferably the member having the outlet bore formed therein is slidably mounted in the end of the casing remote from the inlet to enable the length of the member and the position of the restriction means in the casing to be adjusted. Preferably, also, securing means is provided for securing the member having the outlet bore formed therein in adjusted position relatively to the casing.

Preferably the surface of the restriction means adjacent to the inlet is of frusto-conical shape or substantially frusto-conical shape. Preferably, also the surface of the restriction means remote from the inlet is of frusto-conical shape or substantially frusto-conical shape.

Preferably, the inlet is adapted to be secured to a muzzle of a gun barrel in co-axial alignment therewith, and the outlet is formed in co-axial alignment with the gun barrel's bore. Preferably, also, the casing adjacent to the inlet is provided with a recessed portion of substantially frusto-conical shape.

A preferred embodiment of this invention will now be described, by way of example only, with reference to the accompanying drawings of which:

Figure 1 is a diagrammatic sectional side elevation of a silencer; and

Figure 2 is a diagrammatic sectional side elevation of a modified silencer.

Referring now to Figure 1 the drawings, a silencer for a gun such as, for example, an air rifle, air pistol or other air weapon comprises a substantially cylindrical casing 10 having an inlet 12 formed at one end thereof. The portion of the casing 10 having the inlet 12 therein is provided with an external screw thread 14 to enable the silencer to be secured to the barrel of the gun (not shown) with the inlet 12 in co-axial alignment with the bore of the gun barrel. It will be appreciated that other forms of securing means such as a sleeve fitting could be utilised.

A smooth parallel-sided outlet bore 16 is formed in an end cap 18 which is secured to and closes the end of the casing 10 remote from the inlet 12. The end cap 18 comprises a tubular portion 20 which extends towards the inlet 12 and the bore 16 is arranged to be in co-axial alignment with the inlet 12. The tubular portion 20 extends for at least one half and preferably for two thirds of the length of the casing 10.

The portion of the casing 10 adjacent to the inlet 12 forms an expansion chamber 22 and the portion of the casing 10 surrounding the tubular portion 20 forms a silencing chamber 24.

A flow restrictor 26 is formed on the inner end of the tubular portion 20 and forms a sharp edged orifice to deflect turbulant air flow into the silencing chamber 24. The surface of flow restrictor 26 adjacent to the inlet 12 is of frusto-conical shape and is angled towards the silencing chamber 24 to facilitate the flow of deflected air into the chamber 24. The surface of the flow restrictor 26 remote from the inlet 12 is recessed and is of a substantially frusto-conical shape. The restrictor 26 is dimensioned so that minimal clearance is formed between the outer peripheral edge thereof and the inner surface of the casing 10.

The end wall of the casing 10 through which the inlet 12 passes is provided with a recess 28 which is of a substantially frusto-conical shape. In operation, air flowing from the muzzle of the gun passes into the expansion chamber 22 and turbulant air flow is deflected by the surface of the flow restrictor 26 adjacent to the inlet 12 into the silencing chamber 24.

The frusto-conical shape of the surface of the flow restrictor 26 remote from the inlet 12 tends to reflect back into the silencing chamber 24 any turbulent air flowing therefrom into the expansion chamber 22 thus retaining the turbulent air therein for a suitable time period to effect smoothing and silencing thereof.

The period of time during which the deflected air is retained in the silencing chamber 24 is also at least partially dependent upon the clearance between the outer peripheral edge of the restrictor 26 and the inner surface of the casing 10. Clearly, this clearance

can be varied during manufacture of the silencer to adjust the effectiveness thereof and thus tune the silencer where it is to be used on a particular weapon or in a particular application.

When air flows from the silencing chamber 24 into the expansion chamber 22 around the periphery of the restrictor 26 part of the air flow inpinges upon the surface of the recess 28 and is deflected thereby into the inlet 12 and into the barrel of the weapon (not shown) attached thereto. The inlet 12 and the barrel of the weapon thus form a further chamber which improves the effectiveness of the silencer.

The smooth outlet bore 16 also assists in smoothing the air flowing therethrough to reduce turbulance. In addition, the smooth parallel-sided configuration of the outlet bore 16 allows an air bearing effect to be created when the projectile from the weapon passes therethrough.

Referring now to Figure 2 of the drawings, the parts of the modified silencer shown therein which are the same as the silencer shown in Figure 1 are identified by the same reference numerals and will not be described.

The tubular portion 20 which previously formed an integral part of the end cap 18 is now produced as a separate component and is slidably mounted in the end cap 18. A grub screw 30 is mounted in the end cap 18 and enables the portion 20 to be secured in adjusted position.

It will be appreciated that position of the flow restrictor 26 can be adjusted within the casing 10 to effect tuning of the silencer to optimum efficiencey according to the type of weapon or application in which the silencer is to be used.

In a further modificiation of the silencer shown in Figure 2 of the drawings, the grub screw 30 is dispensed with and the tubular portion 20 is freely slidable in the end cap 18. A helical coil compression spring is mounted on the tubular portion 20 and is confined endwise between the restrictor 26 and the internal surface of the end cap 18. The end of the tubular portion 20 extending from the external surface of the end cap 18 is provided with an enlarged diameter portion to limit inward movement of the tubular portion under the action of the spring. Alternatively, the end cap 18 is divided into two and the outer most portion thereof is secured to the tubular portion 20.

In operation, when the gun is discharged, the restrictor 26 and the tubular portion 20 move slidably relatively to the casing 10 against the action of the spring to a position in which the restrictor 26 is disposed at a suitable location to effect the above described silencing action.

The above described silencers thus effectively damp and silence the noise occasioned by the emission of turbulant air from the muzzle of a gun, yet are of an uncomplicated internal construction.

Although the silencer casing 10 can conveniently be of cylindrical shape, it is envisaged that other shapes of casing could be utilised such as, for example, oval or elliptical cross-sectional shapes.

It has been found that the terminal velocity of a projectile fired from an air weapon having the above described silencers mounted thereon is greater than the normal terminal velocity of a projectile fired from the same air weapon, this increase in terminal velocity being of the order of six per cent. This increase in velocity is an unexpected result and is an indication that the above described silencers facilitate extraction of the propelling air from the air weapon in addition to damping turbulance to effect silencing.

It is envisaged that the above described silencers could therefore be used advantageously on equipment other than air weapons such as the exhaust of internal combustion engines, air or gas operated equipment such as pneumatic drills, turbines or jet engines without departing from the scope of this invention.

In such alternative applications, it will be appreciated that the co-axial alignment of the inlet 12 with the outlet 16 is unnecessary and therefore the configuration of the silencers could be modified so that the inlet 12 and the outlet 16 were offset or indeed disposed at an angle to one another.

CLAIMS

1. Silencing apparatus comprising a casing having an inlet formed therein; an expansion chamber formed in the casing which is connected to the inlet; an outlet in the casing, in the form of a smooth parallel sided bore adapted to act as an air bearing, which is connected to the expansion chamber; a silencing chamber formed in the casing which is only connected to the expansion chamber; and restriction means for restricting communication between the expansion chamber and the silencing chamber wherein the restriction means slopes away from the expansion chamber towards the silencing chamber and is capable of reflecting turbulent gas or air flowing from the silencing chamber towards the expansion chamber back into the silencing chamber.

2. Silencing apparatus according to Claim 1, wherein the smooth parallel-sided outlet bore is formed in a member extending from the end of the casing remote from the inlet towards said inlet.

3. Silencing apparatus according to Claim 2, wherein the outlet bore has a sharp edged orifice formed at the end thereof adjacent to the inlet.

4. Silencing apparatus according to Claim 2 or Claim 3, wherein the restriction means is secured to or formed on the end of the member having the outlet bore formed therein which is adjacent to the inlet.

5. Silencing apparatus according to any one of Claims 2 to 4, wherein the member having the outlet bore formed therein is slidably mounted in the end of the casing remote from the inlet to enable the length of the member and the position of the restriction means in the casing to be adjusted.

6. Silencing apparatus according to Claim 5, wherein securing means is provided for securing the member having the outlet bore formed therein in adjusted position relatively to the casing.

7. Silencing apparatus according to any one of the preceding claims, wherein the surface of the restriction means adjacent to the inlet is of frusto-conical shape or substantially frust-conical shape.

8. Silencing apparatus according to Claim 7, wherein the surface of the restriction means remote

from the inlet is of frusto-conical shape or substantial frusto-conical shape.

9. Silencing apparatus according to any one of the preceding claims, wherein the inlet is adapted to be secured to a muzzle of a gun barrel in co-axial alignment therewith, and the outlet is formed in co-axial alignment with the gun barrel's bore.

10. Silencing apparatus according to any one of the preceding claims wherein the casing adjacent to the inlet is provided with a recessed portion of substantially frusto-conical shape.

11. Silencing apparatus constructed, arranged and adapted to operate substantially as hereinbefore described with reference to, and as illustrated by, the accompanying drawing.

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